OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN AUGUST :—

Aug. 7. Juno in opposition to the Sun (Juno, mag. 8·7).
10. 7h. Saturn in opposition to the Sun.
10–12. Epoch of the August meteors (Perseids, Radiant 45°+57°).
14. 11h. 20m. Minimum of Algol (β Persei).
15. Venus. Illuminated portion of disc=0·983, of Mars=0·986.
17. Saturn. Outer major axis of outer ring=43″·43. Outer minor axis of outer ring=11″·37.
19. 16h. Mercury at greatest elongation (27° 24′ E.).
23. 11h. 6m. to 12h. 33m. Transit of Jupiter's Sat. III. (Ganymede).
24. 8h. Moon in conjunction with Saturn (Saturn 4° 4′ S.).
30. 8h. Moon in conjunction with Jupiter (Jupiter 2° 7′ N.).
,, 14h. 44m. to 16h. 8m. Transit of Jupiter's Sat. III. (Ganymede).
,, 14h. 51m. to 16h. 13m. Moon occults ξ′ Ceti (Mag. 4·5).

THE CENTENARY OF DOPPLER.—We have received from Dr. Karl Haas a copy of the address that he read on the occasion of the celebration of the centenary of the birth of Christian Doppler. It is strange to reflect that Doppler, in 1842, years before Kirchhoff and Bunsen had demonstrated the possibilities of the spectroscope, first announced the principle bearing his name which has since become so famous and so fruitful of application. He himself was not happy in his original suggestion, for he sought to employ the "principle" as a means of explaining the colour of double stars, and it may be that some of the controversy that at one time raged round this question originated in its faulty application, rather than in the generic principle underlying the suggestion. So far as acoustical waves were concerned the matter could be, and was, settled by experiment, and Dr. Haas not only referred to the various tests that had been made to prove the validity of the "principle," but exhibited some of the apparatus that had been employed, and repeated the experiments. Dr. Haas briefly referred to Doppler's strenuous life and work in other departments of natural science, showing that the enunciation of the principle was not a matter of accident, but that it was led up to by philosophical study, and put before the audience the grounds on which Doppler was entitled to their respect. But the valuable work that had been accomplished in the realm of spectroscopy naturally made him linger on this part of the subject, and he gave a useful summary of what has been effected by those who saw how the principle could be applied in special directions; as, for example, Sir William Huggins in the measurement of the motion of stars in the line of sight, Sir Norman Lockyer in the matter of sun-spots and prominences, Dr. Langley and others in the determination of the time of rotation of sun and planets, Prof. Keeler in the spectroscopic observations of the ring of Saturn, and by Dr. Vogel in the department of spectroscopic binaries. M. Belopolsky's scheme for showing experimentally the validity of the principle when applied to light waves was mentioned, while in the department of theoretical physics one was reminded how the application of the same principle was rendering most efficient service. If the centenary served no other purpose, it at least had the effect of tracing the connection between the original thought and its manifold applications.

SATURN'S NINTH SATELLITE (PHŒBE).—The next volume of the "Harvard Annals" is to contain a discussion of Prof. W. H. Pickering's recent observatons of the satellite Phœbe from the photographs obtained at Arequipa.

Meanwhile, in order that other workers may be able to observe this satellite, Prof. E. C. Pickering publishes the following position angles and distances from Saturn on the dates named :—

1904	Position angle	Distance
July 14	... 77°·4	17′·8
July 24	... 79°·8	14′·3
August 3 ...	... 84°·0	10′·5

(*Circular* No. 67, Kiel Centralstelle.)

PRINCIPAL PLANES OF THE STARS.—In the first of a series of papers entitled "Contributions to Stellar Statistics" (published by the Carnegie Institution), Prof. Newcomb discusses "the position of the galactic and other planes toward which the stars tend to crowd."

After demonstrating *in extenso* the formation of the general equation determining the planes, he considers several special cases, and arrives at the following important results, giving the positions of the poles of the respective planes determined :—

	R.A.	Dec.
Galactic plane (omitting branch) ...	192°·8 ...	+27°·2
,, ,, (including ,,) ...	191°·1 ..	+26·8
Gould's belt (as determined from 36 stars, of small proper motion, near it)	179·6 ...	+26·4
Plane of all stars to magnitude 2·5.	181·2 ...	+17·4
,, ,, ,, 3·5.	180·0 ...	+21·5
Plane of fifth-type (Wolf-Rayet) stars	190·9 ...	+26·7

A determination of the mean latitude of 42 points in the main stream of the galaxy shows that this stream is not, on the whole, a great circle, for the mean latitude obtained is −1°·74, showing a small but well marked displacement of our system from the central plane towards Coma Berenices, where the north galactic pole is situated.

Gould's values for the poles of his belt were R.A.=171°·2, dec.=+30°; the value given in the above table reduces his value for the inclination of the belt to the galactic plane by nearly one half.

The above position of the plane containing the Wolf-Rayet stars was determined from the positions of seventy-one such stars (excluding those found in the Magellanic Clouds) communicated by Prof. Pickering, and deviates by only 15′ from the position obtained for the galaxy.

Prof. Newcomb has also investigated the law of "star-richness" of the galactic regions, and among other interesting results records the following numbers as the richness per square degree as determined from the Bonn and Cordoba Durchmusterungs :—

	Bonn DM.	Cordoba DM.
Near galactic pole	8·6 ...	29·9
In rifts of the galaxy ...	19·8 ...	45·7
In the galaxy generally ...	24·6 ...	94·1

This result shows that, neglecting the agglomerations, the galactic density is more than double the other in the northern hemisphere, whilst in the southern it is not more than 50 per cent. greater. The general result indicates that, even neglecting the condensation of the Milky Way, the richness increases considerably from the galactic poles towards the equator.

THE PERSIMMON CREEK METEORITE.—No. 1380, vol. xxvii., of the *Proceedings* of the U.S. National Museum contains an illustrated description of the physical and chemical characteristics of the meteorite found at Persimmon Creek, North Carolina, in the spring of 1893. The weight of the main mass of this meteorite was 9 lb. 6 oz., but a fragment weighing 1 lb. 13 oz. had been previously detached. The date of the fall is unknown, but the general appearance when found indicated that it had lain in the soil for a considerable period, whilst the inspection of a polished surface afforded evidence of its meteoritic origin, and showed that it was composed of a more or less continuous matrix of iron containing troilite, schreibersite, and carbon. Separate analyses of the various constituents were made, and the results are given in the paper.

ENHANCED LINES OF TITANIUM, IRON, AND NICKEL.—In No. 5, vol. xix., of the *Astrophysical Journal*, Mr. Herbert M. Reese, of Yerkes Observatory, gives a list of wave-lengths in the Ti, Fe, and Ni spark and arc spectra respectively, indicating a fair number of new enhanced lines.

The majority of these, however, are only very slightly enhanced, and will require further confirmatory evidence before being finally accepted.

FURTHER EPHEMERIS FOR COMET 1904 *a*.—A supplement to No. 3961 of the *Astronomische Nachrichten* contains a continuation of the ephemeris published by Prof. Nijland in No. 3951 of that journal. This ephemeris gives the positions of the comet for every alternate day from July 18.

to October 30, but, as the comet will be only 0·3 of its original magnitude on July 30, and is still decreasing, it is scarcely worth while reproducing it here.

The R.A. is varying but little, and on August 1 will be 12h. 16m. 40s., whilst the declination is slowly decreasing, and on the same date will be +47° 34′·6.

A MODIFIED FORM OF THE NEWTONIAN REFLECTOR.—In the *Monthly Notices* for May, 1895, the Rev. Chas. Davies described a modified form of Newtonian reflector in which the rays from celestial objects fell on a large plane mirror fixed at the open end of a horizontal tube, and were thereby reflected on to an ordinary parabolic mirror fixed at the other end, afterwards being brought to a focus through an aperture in the centre of the plane mirror to which was affixed the observing eye-piece. A movement of the plane mirror about the optical axis, and of the horizontal tube in azimuth, allowed any point in the sky to be reached.

By fixing the telescope in a fork at the upper end of a polar axis, M. E. Schaer, of Geneva, now proposes to modify this instrument so that, whilst retaining its original advantages, such as the unchanging position of the eye-piece, it may be used like an ordinary equatorial and cœlostat, and by the simple rotation of the polar axis by clockwork the object may be kept stationary in the centre of the field. In this arrangement the mirrors are so placed that they suffer very little from flexure caused by changes of position. Using a model instrument constructed on these lines M. Schaer found that the practical results were excellent (*Astronomische Nachrichten*, No. 3958).

SEISMOLOGICAL NOTES.

THE sixteenth number of the *Publications* of the Earthquake Investigation Committee in Foreign Languages (Tokyo) consists of 117 quarto pages of print and 9 full-page illustrations. The subject is on Milne horizontal pendulum seismograms obtained at Tokyo, the author of which is A. Imamura, assistant professor of seismology at the Imperial University of Tokyo.

While discussing amplitudes, it is pointed out that these quantities may be increased or decreased according to the relationship existing between the periods of earth movements and the period given to the pendulum, an objection, as has frequently been pointed out, to pendular apparatus in general. Out of a list of 298 records (July 24, 1899, to December 24, 1902), the more important are considered in relation to corresponding records obtained from other types of instruments in Japan, and from similar types of instruments in various parts of the world, the registers from which are issued biannually by the British Association. The more important results relate to the speeds with which different phases of earthquake motion have been propagated over paths of great length. By means of more than forty diagrams, each referring to a particular earthquake, speeds along arcual paths for several of the more important phases of motion are represented by straight lines, that is to say, the speeds are constant. For certain disturbances the evidence leads us to this conclusion, but this is not the case for all. For example, in Fig. 4, a diagram similar to publications by the British Association (Report, 1902, p. 66), we notice in connection with the preliminary tremors that the longer the wave path the greater are the divergencies among the observations which give the time interval to traverse the same. The time taken to travel 25° has apparently varied between 3·5 and 4 minutes, that is to say, the observations agree within 30 seconds. For 80°, however, the divergence is 5 minutes, while on still longer paths the intervals are still greater. When we look at these variations as shown on squared paper, we should certainly hesitate before representing their mean position by a straight line. If, however, it is a straight line, and we know the recording instruments to be similar, then one inference is that minute tremors which may be recorded at a station near to an origin may have failed to reach or to make themselves evident at stations which are very remote.

But why should earthquake vibrations fall in line with the vibrations of elastic bodies? If our world has a fluid or gaseous nucleus, Arrhenius, Fisher, and other physicists and geologists see in the same an explanation for many phenomena. Convection currents might explain slight changes in latitude (Fisher), and they certainly suggest variability of velocity along the same path.

Although we do not agree with all Mr. Imamura's conclusions, seismologists are indebted to him for a piece of valuable research.

In vol. ii., No. 6, of the reports of the Tokio Physico-mathematical Society Mr. K. Honda gives an account of the daily periodic changes in the level in an artesian well the depth of which is 380 m. with a water head within 3·2 m. of the surface of the ground. What he found was that there were two maxima and minima every twenty-four hours, the range of motion varying between 3 cm. and 1 cm. (For somewhat similar experiments made in a shallow well close to the bore-hole here considered, see Reports Brit. Assoc., 1895, p. 104.)

Near to the days of full and new moon the movements are marked and regular; the phases of maxima and minima agree with those of the tides in Tokyo Bay. The well sinks with a high barometer and rises with a low barometer. Rain does not affect the level. By experiment it was found that variation of pressure of 1 mm. of mercury produced a change in the level of the water of 13·5 mm. An equal natural pressure acting on the water head causing it to sink, and on the surrounding ground causing it to rise, only results in a level change of 4·35 mm. From this it is concluded that the earth's crust only transmits 68 per cent. of pressure on its surface to a depth of 380 m. Another conclusion is that the daily fluctuation of 1 to 3 cm. is more likely to be a tidal than a barometrical effect. The distance to the sea is 3 km. In a deep well in Yokohama 0·6 km. from the sea, the tidal effect results in a change of level of 16 cm. This extremely interesting paper concludes with references to the frequency of earthquakes in relationship to fluctuation in barometric and tidal loads. In No. 9 of the same reports Mr. Honda gives a continuation of similar researches carried on at three other deep wells, at the end of which he shows that earthquakes with a submarine origin are most frequent when tidal pressure is at maximum, a minimum, and when the rate of pressure is changing most rapidly. No. 8 of the *Journal* is from the pen of Dr. F. Omori, who shows, chiefly from the consideration of after shocks, that earthquake frequency is affected by changes in atmospheric pressure.

Consul G. Pára, of Uskub, gives (*Kaiserliche Akad. d. Wissenschaften in Wien*, April 21, No. 10) a few statistics relating to the destruction caused by the earthquake which on April 4 disturbed the Balkans. This is followed by further details of a more geological character by Prof. R. Hoernes. The phenomena described are of an ordinary character.

Under the title of "L'Eruzione dell' Etna in 1892," (vol. i.), in a large quarto volume, the director of the observatory in Catania, Prof. A. Ricco, and S. Arcidiacono give a detailed account of the phenomena which accompanied the eruption of Etna in 1892. As an assistance to the better understanding of the historical sequence in events, this is prefaced by accounts of the eruptions of 1883 and 1896, all of which took place on the line of a radial fracture at points from 1000 to 1500 m. lower than the main central crater. It is essentially a volume of observations of value to the vulcanologist, to be followed at a later date by deductions.

In the *Bollettino dell' Accad. Gioenia, Catania*, fas. lxxix., December, 1903, S. Arcidiacono gives a short account of earthquakes which recently disturbed Etna, and which were of local origin. From a tabular statement of these it appears that from 1898 seismic activity was fairly uniform and not pronounced, but after the eruption of 1902 it became three-fold.

The first paper in the *Bollettino della Società Sismologica Italiana* (vol. ix., No. 9, 1903–4), by M. Tito Alippi, relates to the possible relationship of *bonniti* and *bombiti* (mist poeffers, barisal guns, &c.) to seismic movements. From a list of seismic disturbances recorded in a district where *bonniti* were frequent, it does not appear that the two phenomena are connected. The multiplication of the seismograph was, however, only 12. Had it possessed ten times this sensibility it might have responded to minute